Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

Redline (Build 5) ***and Blueline(Build6)*** ***change to*** **ICD for Product Specification 2620003**

Modified product:

20 MESOCYCLONE (M, MRU, MD, DMD)

SSS Product Description
"This product shall provide information about identified shear and mesocyclone features. This product shall be generated from the output of the Legacy Mesocyclone Detection Algorithm. This product shall be generated in a format that can be used to generate an alphanumeric tabular display for an identified feature or all simultaneously, a graphic display or a graphic overlay to other products. This product shall be updated once per volume scan time. If on a particular volume scan there is no output from the Legacy Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, radar position, radar elevation above MSL, and radar operational mode. Upon user request, all site adaptable parameters identified as input to the algorithm(s) used to generate data for this product shall be available at the alphanumeric display."

"A Mesocyclone Rapid Update (MRU) version of this product shall be generated once per elevation scan time to provide updated Legacy Mesocyclone Algorithm information. Current Legacy Mesocyclone Algorithm data at an elevation scan shall be based on the elevations that have been completed thus far in the current volume scan. This information shall be combined with Mesocyclone and Storm Track Algorithm information from the previous volume scan to form the MRU product. The motion of the storm cell associated a feature from the previous volume scan shall be used to derive a forecast position of the feature at the current volume scan time. If a particular storm cells motion is not available, the average storm motion shall be used. In feature type order, the forecast position of each feature from the previous volume scan shall be matched to the closest feature from the current volume scan, within a search radius defined by SCIT algorithm adaptation data. Current features which are not matched to a feature from the previous volume scan, shall be identified as being new. If previous volume scan data is unavailable, all features shall be identified as new. Current features shall inherit the attributes of the matched previous feature (associated storm ID, feature type, maximum tangential shear, height of maximum tangential shear, top height, base azimuth, base range, base height, azimuth diameter, range diameter). The position attributes (base azimuth, range, and height) of a previous feature matched to a current feature shall be updated to the current detection. The position attributes of a previous feature not matched to a current feature, shall be set to the extrapolated forecast position. Attributes which represent strength shall be updated if they increase in magnitude. The strength attributes are: feature type and maximum tangential shear. If the maximum tangential shear is updated, the radial and azimuthal diameters and the height of the maximum shear shall also be updated. Attribute data updated from current volume data shall be identified. At the end of the volume scan, the feature top height shall be updated and extrapolated features shall be removed. This product shall be generated in a format that can be used to generate an alphanumeric tabular display, a graphic display or a graphic overlay to other products. If on a particular elevation scan there is no output (i.e., no features of any

type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode."

"The MD version of this product shall provide information about circulation features generated from the output of the new Mesocyclone Detection Algorithm (MDA). This product shall provide information concerning the past and future positions of each tracked circulation feature. This product shall be generated in a format that can be used to generate an alphanumeric tabular display for an identified feature or all simultaneously, a graphic display or a graphic overlay to other products. This product shall be updated once per volume scan time. If on a particular volume scan there is no output from the Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, radar position, radar elevation above MSL, and radar operational mode."

"A data array (DMD) version of this product shall be generated to support generation of interactive user displays at an external system (e.g., AWIPS). This product shall be updated once per elevation scan time. The end-of-volume edition shall contain complete algorithm data for the volume scan. The elevation editions shall contain the algorithm data which has been updated since the previous volume edition product. A detection status shall be reported for circulation features that are topped or extrapolated. If on a particular elevation scan there is no output from the Mesocyclone Detection Algorithm (i.e., no features of any type are identified), a version of the product shall be produced that exhibits the negative condition. This product shall include annotations for the product name, radar ID, date and time of volume scan, elevation angle, radar position, radar elevation above MSL, and radar operational mode. "

20.2 Display Format

20.2.1 Graphic Display

The products are displayable in full- or quarter-screen format (see Appendix C).

20.2.1.1 Data Display

The mesocyclone or 3D correlated shear symbol will be placed directly over the position of the mesocyclone or shear at the lowest elevation scan in which it was detected.
For the MRU product: extrapolated mesocyclone and 3D correlated shear features will be displayed centered on the forecasted position at the lowest elevation scan it was previously detected; mesocyclone and 3D correlated shear features detected in the current volume scan will be displayed centered on the position of the matched current feature at the lowest angle in which it is detected. See also Appendix A, I(B)(4).

For the MD version, the graphic display will contain up to 100 MDA detected features, sorted first by strength rank, then by Mesocyclone Strength Index (MSI). The number of features in the product can be reduced by raising the minimum display filter rank and/or activating the overlap filter, both MDA adaptable parameters.

When sufficient data is available, the past positions for each volume scan (up to 10 past volume scans) will be shown along with the current position and up to six future positions (at 5 minute intervals). The past positions will be displayed at the lowest elevation each MDA feature was detected. MDA tracks will consist of past, current and forecast positions connected by one pixel wide linear segments. The operator at the external display system (e.g., AWIPS) will have the ability to select whether to display the past and/or forecast tracks and positions and feature IDs.

In the event an identified MDA feature forecast speed is less than 2.5 m/s the feature motion is considered stationary. For stationary MDA features, a single past position will be reported at the current feature center.

20.2.1.2 Range/Data Resolution

Coverage Area (nmi radius)	Resolution (nmi x nmi)	Product Center
0 to 124	N/A	Radar location

20.2.1.3 Graphic Overlay

As a graphic overlay to other products, it will be possible to display only the image portion of this product; that is, the screen right area annotations will not be displayed when the product is used as an overlay. Each mesocyclone will be identified with the associated storm ID in white. In overlay form, the mesocyclone and 3D shear symbol have pixel priority over all but the TVS symbol. The mesocyclone and 3D shear symbols, which are displayed in yellow, flash when displayed as overlays. The operator will have the option to stop the flashing of the mesocyclone symbol.

For the MRU version, the AWIPS operator will have the option to turn off display of extrapolated features.

For the MD version, circulations strong enough to be classified as mesocyclones will be identified with the Circulation ID (0 to 999) displayed next to the mesocyclone symbol.

20.2.2 Alphanumeric Display

An alphanumeric tabular product version is generated for display on the alphanumeric display. The format to be used is defined in Appendix C.

With the following exceptions, the format of the MRU graphic attribute and alphanumeric tabular portions of the product will follow the non-rapid update Mesocyclone product: feature status will be reported as EXT, PER, INC, and, NEW to denote extrapolated, persistent, increasing, and new features, respectively; and the character ^ (hexadecimal value 5E) will be placed next to data which was computed from current volume scan detections. The format to be used is defined in Appendix B and C.

For the MD version, up to 100 features will be listed from highest to lowest strength rank with Mesocyclone Strength Index (MSI) as a secondary order (highest MSI to lowest MSI).

20.3 Annotations

20.3.1 Alphanumeric
Standard annotations
Site Adaptable Parameters for the ~~non-rapid update~~ legacy version
Elevation angle for the MRU version
All annotations (except for Radar position) with the alphanumeric product format will be included in the message.

20.3.2 Special Symbols
The mesocyclone will be displayed (centered on the location of the mesocyclone at the lowest elevation angle in which it is detected) as a yellow open circle, whose perimeter is 4 pixels thick. The size of the symbol will be proportional to the average of the mesocyclone radial and azimuthal diameters. The minimum size symbol will be a circle having a diameter of 14 pixels.

The 3D correlated shear will be displayed as a yellow open circle, 1 pixel thick and is centered (similarly to the mesocyclone) on the 3D shear center at the lowest elevation angle at which it was detected. The size will be proportional to the average diameter. The minimum size symbol will be a circle having a diameter of 14 pixels.

For the MRU version, AWIPS will distinguish between the Mesocyclone and 3D correlated shear features will by the thickness of the perimeter of a circle (i.e., thick perimeter is a Mesocyclone and thin for 3D Correlated Shear). In addition, AWIPS will distinguish between current (new, persistent, and increasing) and extrapolated (unmatched) 3D features by the line style of the circle perimeter (i.e., traditional AWIPS mesocyclone and 3D Correlated shear symbols are used for current features, but symbols with a dashed perimeter are used for extrapolated features).

For the MD version, features having a strength rank 5 will be displayed similar to the legacy Mesocyclone symbol. In addition, if the feature's base was detected on the lowest elevation angle, or its base height was at or below 1 kilometer, the Mesocyclone symbol will contain outward spikes. For MDA features having a strength rank less than 5, the symbol will be similar to the legacy 3D correlated shear symbol. The size of the symbol will be drawn to scale with the base level feature diameter.

The MDA track consists of past, current, and forecast feature positions connected by one pixel wide linear segments. Past positions will be displayed as yellow filled diamond. Forecast positions will be displayed as yellow x cross signs, of similar size.

20.4 Product Interaction
This product is displayable as an overlay on all geographically based products. For the MRU version, the AWIPS operator will be provided the option to choose between displaying the latest elevation (i.e., highest elevation) and displaying a specific elevation; when the latest

elevation is selected, the display will automatically update when higher elevation products are received.

20.5 Comments
All site adaptable parameters identified as inputs to the algorithm used to generate data for this product will be available for display at the applications terminal upon user request. See 12.8 for the format description.

The current value of the three MDA adaptable parameters will be placed in a corner of the graphic overlay display. If there are no features, the text "No Circulations" will be placed on the graphic display

APPENDIX A - Annotations, Symbols, Abbreviations, and Display Features
(B) Special Symbols and Characters

(4) Mesocyclone

The mesocyclone will be displayed (centered on the location of the mesocyclone at the lowest elevation angle in which it is detected) as a yellow open circle, whose perimeter is 4 pixels thick. The size of the symbol will be proportional to the average of the mesocyclone radial and azimuthal diameters. The minimum size symbol will be a circle having a diameter of 14 pixels. See section 20.3.2 for MRU, MD, and DMD special symbol product requirements.

(5) Correlated 3D Shear

The 3D correlated shear will be displayed as a yellow open circle 1 pixel thick and is centered (similarly to the mesocyclone) on the 3D shear center at the lowest elevation angle at which it was detected. The size will be proportional to the average diameter. The minimum size symbol will be a circle having a diameter of 14 pixels. See section 20.3.2 for MRU, MD, and DMD special symbol product requirements.

II. Standard and Product Specific Annotation Display
4) Display of Storm Attribute Data

Configuration 2C, associated with the Mesocyclone Detection (MD) product closely follows the Mesocyclone product. Differences are described in section 20.2.2. The table outline for the MD attribute data shall be yellow. Due to a limit of 6 pages, only the strongest 36 MDA features are included in the Attribute Data. The MD product is a stand alone product as well as an overlay product and the manner in which Configuration 2C is handled is the same as that of Configuration 1.

TABLE III. STANDARD ABBREVIATIONS

SS Products	Abbreviations
Mesocyclone Detection	MD
Digital Mesocyclone Detection	DMD

Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

APPENDIX B - Graphic Display Formats

CONF 2C

CIRC ID	XXX	
SR LLRV	XXa XXX	
AZ RAN	XXX XXX	
HGT MXRV	XX XX	
BASE DPTH	<XX >XX	

NTR 20 MESOCYCLONE DETECTION

NOTE: CIRCULATIONS LISTED FROM HIGHEST TO LOWEST STRENGTH RANK.

APPENDIX C - Alphanumeric Tabular Formats

MESOCYCLONE DETECTION ALGORITHM

RADAR ID: NNN DATE: MM/DD/YY TIME: HH:MM:SS Avg dir/spd: XXX/XXX

CIRC ID	AZRAN deg/nm	SR	|-LOW LEVEL-| RV	DV	BASE	|--DEPTH--| kft	STMREL%	|-MAX RV-| kft	kts	TVS	MOTION deg/kts	MSI
XXX	XXX/XXX	XXa	XX	XX	<XX	>XX	XX	XX	XX	X	XXX/XXX	XXXXX

Format IIIc. Mesocyclone Detection (Sheet 1 of 1)

Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

Redline (Build 5) ***and*** ***Blueline(Build6)*** ***changes*** **to ICD for RPG to Class I User 2620001**

Table IIa. Product Dependent Halfword Definitions for Product Request Message

Product Name	Msg Code (s)	Half-Word #	Content	Units (INT*2)	Range	Accuracy/ Precision
Digital Mesocyclone Detection	149	22	Elevation Angle	Degrees	-1.0 to 45.0	.1, Note 1,9

Table III. Message Codes for Products

CODE	NTR	PRODUCT NAME	RESOLUTION	RANGE	DATA LEVEL	MESSAGE FORMAT
141	20	Mesocyclone Detection	N/A	124	N/A	Geographic and Non-geographic Alpha
149	20	Digital Mesocyclone Detection	N/A	124	N/A	Generic Data Format

Table V. Product Dependent Halfword Definition for Product Description Block

Product Name	Msg Code	Hword#	Content	Units	Range	Accur/Prec
Mesocyclone Detection	141	27	Adaptation Data setting for Minimum Reflectivity Threshold	dBZ	-25 to 35	1
Mesocyclone Detection	141	28	Adaptation Data setting for Overlap Display Filter	N/A	0 or 1	0 = overlap filter OFF 1 = overlap filter ON
Mesocyclone Detection	141	30	Adaptation Data setting for Minimum Display Filter Strength Rank	N/A	1 to 5	1
Digital Mesocyclone Detection	149	27	Adaptation Data setting for Minimum Reflectivity Threshold	dBZ	-25 to 35	1
Digital Mesocyclone Detection	149	30	Elevation Angle	Degree	-1.0 to + 45.0	.1

Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

Graphic Information Block:

3.2.1.3 Graphic Alphanumeric Block

Product Code	Product Name
141	Mesocyclone Detection
149	Digital Mesocyclone Detection

Table VII. Product Dependent Definition for Graphic Alphanumeric Block

PRODUCT NAME	CONTENT	UNITS	RANGE	ACCURACY/ PRECISION	REMARKS
MESOCYCLONE DETECTION	Circulation ID	N/A	0 through 999	N/A	The sequence is recycled following 999
	Strength Rank	N/A	1 to 25	1	If the strength rank was computed by the Low-Top or Shallow method, an L or S will also be displayed.
	Low Level (base) Rotational Velocity	Kts	0 to 129	1	
	Position: • Azimuth • Range	 Degrees nmi	 0 to 360 0 to 124	 1 1	Base 2D feature component
	Height of Maximum Rotational Velocity (ARL)	Kft	0 to 33	1	
	Maximum Rotational Velocity	Kts	0 to 129	1	

	Base Height (ARL)	Kft	0 to 33	1	If the Base is on the lowest elevation scan or below 1km, then it is preceded by a "<" in the display.
	Depth	Kft	0 to 33	1	If the Base is on the lowest elevation scan or below 1km, then the Depth is preceded by a ">" in the display

Tabular Alphanumeric Block:

3.2.1.4 Tabular Alphanumeric Block

Product Code	Product Name	Block 3 Message Code
141	Mesocyclone Detection	141

Table VIII. Product Dependent Definition for Tabular Alphanumeric Block

PRODUCT NAME	CONTENT	UNITS	RANGE	ACCURACY/ PRECISION	REMARKS
MESOCYCLONE DETECTION	Radar ID	N/A	0 to 999	1	
	Volume Scan Start Date	N/A	Months: 1 to 12 Days: 1 to 31 Years: 0 to 99	N/A	
	Volume Scan Start Time	N/A	Hours: 0 to 23 Minutes: 0 to 59 Seconds: 0 to 59	N/A	

Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

	Average Motion: • Direction • Speed	Degrees Kts	 0 to 360 0 to 129	 1 1	Average of all MDA detected circulations regardless of whether they meet minimum display thresholds.
	Circulation ID	N/A	0 through 999	N/A	The sequence is recycled following 999
	Position: • Azimuth • Range	 Degrees nmi	 0 to 360 0 to 124	 1 1	Base 2D feature component
	Strength Rank	N/A	1 to 25	1	If the strength rank was computed by the Low-Top or Shallow method, an L or S will also be displayed.
	Low Level (base) Rotational Velocity	Kts	0 to 129	1	
	Low Level (base) Gate-to-Gate Velocity Difference	Kts	0 to 129	1	
	Base Height (ARL)	Kft	0 to 33	1	If the Base is on the lowest elevation scan or below 1km, then it is preceded by a "<" in the display.

Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

	Depth	Kft	0 to 33	1	If the Base is on the lowest elevation scan or below 1km, then the Depth is preceded by a ">" in the display
	Storm Relative Depth Percentage	Percent	0 to 100	1	Based on the average depth of the ten SCIT identified storm cells having the highest cell based VIL.
	Maximum Rotational Velocity	Kts	0 to 129	1	
	Height of Maximum Rotational Velocity (ARL)	Kft	0 to 33	1	
	TVS	N/A	Y or N	N/A	Y if a TVS is detected within 2 km of Position
	Motion	deg/kts	0 to 360 deg 0 to 99 kts	1 deg 1 kt	Motion of this MDA detection or blanks if detection not tracked.
	Mesocyclone Strength Index	N/A	0 to 99999	1	See MDA AEL.

Figure 3-8b Write Special Symbols (no value) Add the following note:
The special symbol characters in use are: !(21), "(22), #(23), $(24), %(25) to report past storm cell position, current storm cell position, forecast storm cell position, past MDA position, and forecast MDA position, respectively. Where, the number in parenthesis is the 8-bit hexadecimal value for the ASCII character. The appearance of the special symbols (e.g., filled circles, plus marks, X within a circle) is described in the Product Specification ICD (2620003), sections 18.3.2 and 20.3.2.

Figure 3-14. Special Graphic Symbol Packets

	MSB HALFWORD LSB
	PACKET CODE (=20)
POINT FEATURE	LENGTH OF BLOCK (BYTES)
REPEAT FOR EACH SYMBOL	I POSITION
	J POSITION
	POINT FEATURE TYPE
	POINT FEATURE ATTRIBUTE

Mesocyclone Products (MD: RPG Build 5, DMD: RPG Build 6)

FIELDNAME	TYPE	UNITS	RANGE	PRECISION/ ACCURACY	REMARKS
Packet Code	INT*2	N/A	20	N/A	Packet Type (Note 1)
Length of Block	INT*2	Bytes	8 to 32760	1	Number of bytes in block not including self or packet code
I Position	INT*2	Km/4	-2048 to +2047	1	I starting coordinate
J Position	INT*2	Km/4	-2048 to +2047	1	J starting coordinate
Point Feature Type	INT*2	N/A	1 to 4	1	1 = mesocyclone (extrapolated) 2 = 3-D correlated shear (extrapolated) 3 = mesocyclone (persistent, new, or increasing) 4 = 3-D correlated shear (persistent, increasing, or new) 9 = MDA Circulation with Strength Rank >= 5 AND with a Base Height <= 1 km ARL or with its Base on the lowest elevation angle. 10 = MDA Circulation with Strength Rank >= 5 AND with a Base Height > 1 km ARL AND that Base is not on the lowest elevation angle. 11 = MDA Circulation with Strength Rank < 5
Point Feature Attribute	INT*2	Type dependent, see remarks.	Type dependent, see remarks.	Type dependent, see remarks.	For feature types 1-4, 9, 10, 11, radius in km/4